NESTING ECOLOGY OF THE PIED-BILLED GREBE IN NORTHWESTERN IOWA[1]

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I OBTAINED nesting data on the Pied-billed Grebe (*Podilymbus podiceps*) from March to September, 1948, at Smith's Slough, Dewey's Pasture, and Mud Lake, typical prairie pot-hole marshes about four miles north of the

FIG. 1. Uncovered Pied-billed Grebe nest near Ruthven, Iowa, June 10, 1948.

town of Ruthven, Palo Alto County, Iowa. I am indebted to Dr. H. M. Harris, Head of the Department of Zoology and Entomology, Iowa State College, for encouragement during the work and to Dr. William Stadelman, Washington State College, for aid in searching for nests.

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Migration

In 1948, I first saw Pied-billed Grebes in the northwest Iowa lake region on March 29. This was approximately one week earlier than the date of earliest spring arrival given by Larson (1925) and two weeks earlier than Spurrell's (1917) earliest record for Sac County, Iowa. In the first week of their spring migration, I recorded less than a dozen individuals. Other spring migrants arriving in the area about this same time were the Lesser Yellow-legs (*Totanus flavipes*), Pectoral Sandpiper (*Erolia melanotos*), Wilson's Snipe (*Capella gallinago*), Great Blue Heron (*Ardea herodias*), and Whistling Swan (*Olor columbianus*). I noted an influx of about 200 grebes the second week in April. At this time, open water areas in the marshes that were relatively free of vegetation and varying in depth from 15 to 25 inches constituted the type of habitat used by the grebes. As nearly as I could determine by daily censuses, approximately 1,000 Pied-billed Grebes passed through the research area during spring migration in 1948.

Courting

The first evidence of courting and subsequent pair formation that I observed was on one of the ponds in Dewey's Pasture on April 20. My observations of Pied-billed Grebes indicated that they utilized the open-water areas in the marshes for courting. For the most part, the courting behavior was as follows: The male grebe, with his head held low and his bill slightly above the surface of the water, approached the female by swimming slowly. The wings of the male were arched slightly during his approach. When the male was about four feet from the female, he dived and came up at the side but slightly to the rear of the female. The female then made a short dash, varying from four to ten feet, propelling herself with rapid movements of the feet and wings. The male quickly followed and overtook the female at the end of her short dash. As the male then climbed on the female's back, she lowered the front part of her body and extended her neck, seemingly to offset the weight of the male. In lowering the front portion of her body, the female raised her tail slightly. The male grasped her at the nape of the neck with his bill and by beating his wings rapidly and using his feet maintained his balance on the back of the female. With both birds rolling considerably in the water, they united in copulation. The female was entirely submerged during the brief period of copulation.

Sometimes the male was thwarted in his courting attempts by the unreceptive female suddenly diving at the end of the short dash rather than remaining on the surface. In such cases, the male immediately dived and followed the female, but I did not observe copulation to follow this sequence of events.

On May 26, I recorded a pair of Pied-billed Grebes that copulated at least six times in one day. On another occasion. a pair copulated three times in less than five minutes.

The peak of the breeding activity, as shown by courtship and copulation, occurred during the last week of May and the first three weeks of June. Courting antics were not limited to the early part of the breeding season. In fact, I recorded Pied-billed Grebes in courtship. with decreasing regularity, up to August 5.

Territoriality

Pied-billed Grebes exhibited territorial behavior about their nests and I plotted a total of 44 territories. The area defended usually was included within an arc of about 150 feet around the nest. Since male Pied-billed Grebes are slightly larger than females, I could determine that the male was usually the one that defended the area. However, I observed the female to "back up" the male several times in his defense. In one instance a female defended her nesting territory against the intrusion of a coot. The female grebe pursued the coot for about 15 feet and then returned to the vicinity of the nest. Beyond the territorial limits, both sexes joined with other Pied-billed Grebes to feed together without strife. Most of the nests I located were near the shoreline and territorial defense was common in that area, but in the deep, open-water areas, I observed as many as eight pairs feeding together without conflict. The home range or area utilized for carrying on the daily activities was usually about twice the size of the nesting territory.

Nesting

From April 25 to 30, 1948, I found the nests of Pied-billed Grebes in all stages of construction on the study area. As nearly as I could determine, the male assisted the female in nest construction by gathering nesting material. The bulk of the nest material, however, was gathered by the female in the immediate vicinity of the nest. After forming a crude, circular platform of old but buoyant vegetation, frequently bulrush stems grown the previous year, the female continued to build the platform into a truncated cone until it would support her weight above the water. Then while standing in the center of the platform, she pulled the old, rotted vegetation up around the edges to form the cup. The water-soaked vegetation was pulled from the outside and draped towards the center. The time required for completion of the nest varied from three to seven days and appeared to depend upon the availability of nesting materials and possibly the physiological development of the individual female. Completed nests were sodden masses of decaying, aquatic vegetation (Fig. 1).

I took measurements on 138 Pied-billed Grebe nests in the course of this study and tried to determine the relationship of the nest site to the physical surroundings (Table 1). Eighty-seven per cent of the nests I located were within 50 feet of an open-water area in the marshes. The mean distance from nest to open water was 25.8 feet.

TABLE 1

LOCATION OF 138 PIED-BILLED GREBE NESTS, RUTHVEN, IOWA, 1948

Distance to Shore		*Distance to Open Water*		*Water Depth*	
Feet	Nests	Feet	Nests	Inches	Nests
1–100	63 (45.7%)	1– 20	84 (60.8%)	1–10	19 (13.7%)
101–200	16 (11.6%)	21– 40	26 (18.9%)	11–20	55 (39.9%)
201–300	13 (9.4%)	41– 60	14 (10.2%)	21–30	32 (23.2%)
301–400	13 (9.4%)	61– 80	6 (4.3%)	31–40	26 (18.9%)
401–500	33 (23.9%)	81–100	8 (5.8%)	41–50	6 (4.3%)

Egg laying began about the first week of May and I recorded the first nest with two eggs on May 2. I located a total of 137 nests that were built by Pied-billed Grebes but not utilized. This indicated that each pair of nesting pied-bills probably built at least two nests during the course of the breeding season, one apparently as an early nesting attempt while the other was the true nest with eggs. Data on the rate of egg laying revealed that usually one egg was laid each day but that sometimes a day was skipped towards the completion of the clutch. Mean measurements of 102 eggs were 43.53 ± 0.69 by 30.85 ± 0.44 mm. The size of the clutch varied from two to ten eggs with the mean for 97 successful clutches being 6.18 ± 0.40 and for 41 unsuccessful clutches, 4.34 ± 0.63.

During the period of egg laying and in the early stages of incubation, the grebes gave slight attention to the nest. This information I obtained by using a thermocouple concealed in the center of a nest containing a clutch of five eggs that had been incubated at least two days. The female came to the nest several times during the morning and late afternoon to rearrange or add material. On only four visits to the nest did the female attempt to incubate the eggs, and eight minutes was the longest time spent upon the eggs during this stage of incubation. Unfortunately, the nest was destroyed four days after the first data were collected and time did not permit further investigation along this line. Deusing (1939) reported that in the latter stages of incubation both sexes assisted in incubation and left the nest only for brief periods.

Just prior to the time of hatching, I observed the female removing the loose, protective covering of vegetation from around the eggs and making the interior of the nest smooth by adding small quantities of fibrous, green algae. The hatching period for a typical clutch of six eggs was spread over two days. From the first sign of pipping to the actual emergence of the young took from one-half hour to two and a half hours depending upon the climatic conditions. Each young emerged from its shell about as fast as its down dried. The embryonic membranes were shed last over the tail and around the anus. The first young of the season, which appeared to be two to four days old, I observed on June 16 on Smith's Slough. I think that the peak of hatching time was about June 26, but nests with eggs were recorded to August 8.

Productivity

Of the 138 Pied-billed Grebe nests with eggs examined in this study, 70.4 per cent (97 nests) were successful. A mean clutch of 6.18 ± 0.40 eggs were deposited in the 97 successful nests; of these 5.58 ± 0.46 hatched. From these data, I judged that approximately 541 young were produced from the nests studied.

Nest Losses

I attributed about 50 per cent of the nest destruction during the 1948 breeding season to climatic conditions such as wind and wave action and fluctuating water levels. Raccoons (*Procyon lotor*) were responsible for approximately 25 per cent of the nest destruction and were the major predator on the Pied-billed Grebe nests.

The location of the nest site seemed to affect the degree of nesting success. The 97 successful nests that I located were at a mean distance of 305.68 feet from the shore while the 41 unsuccessful nests had a mean distance from shore of 110.63 feet. Application of the "t" test to the data revealed a significant difference in the means ($t=66.34$, .01 level$=2.610$). My field observations substantiated these data, for the nests located nearest to the shoreline were those that both received the greatest predator pressure and were subjected most to stranding by fluctuating water levels. I did not find any significant correlation between nesting success and the distance the nest was located from open water. However, I did find a significant difference between successful nests (mean depth 24.2 inches) and unsuccessful nests (mean depth 16.4 inches) with regard to water depth at the nest site ($t=8.439$, .01 level$=2.610$).

A comparison of the nest measurements between successful and unsuccessful nests showed only slight and seemingly insignificant differences in construction.

Data on the 138 Pied-billed Grebe nests revealed the following general measurements: outside diameter, 15 inches; inside diameter, 5 inches; height of cup rim above waterline, 3 inches; bowl depth, 2 inches; and thickness of material under bowl, 2 inches.

Nesting Cover

From data obtained on 85, 1/4000-acre quadrats (measuring 3.3×3.3 feet), I was able to make a quantitative evaluation of the nesting cover utilized by the Pied-billed Grebe. I located each quadrat or vegetation study plot with the nest as the center and the sides oriented with the cardinal points of the compass. For each quadrat I recorded: the species of plants present, vegetation height, frequency of plant stems, per cent of plot cover formed by each plant species, and basal area of each plant species. I also made estimates of the density of the surrounding vegetative cover and the amount of floating, dead vegetation present in the water. Nineteen species of plants occurred in the 85 quadrats, but only six species were present on 20 per cent or more of the quadrats. The data are summarized in Table 2. Gabrielson (1914) reported that Pied-billed Grebes also utilized cattails (*Typha* sp.) for nesting cover.

Table 2

Nesting Cover Analysis of 85, 1/4000-acre Quadrats, Ruthven, Iowa, 1948

Plant Species	*Stem Frequency*			*Per cent of cover*		*Basal Area (square inches)*	
	Total	Plots	Mean	Range	Mean	Range	Mean	Range
Eleocharis macrostachya	17,705	46	384.8	13–1272	56.0	3–100	2.87	0.25–7.50
Scirpus acutus	5,967	33	180.8	4– 460	77.6	1– 50	4.16	0.50–7.00
Scirpus heterochaetus	4,300	20	215.0	6– 821	49.3	1– 90	3.87	1.00–9.75
Sparganium eurycarpum	2,283	18	126.8	8– 469	40.3	3–100	3.44	0.50–8.50
Sagittaria cuneata	619	21	24.7	2– 115	8.9	2– 30	0.92	0.25–3.00
Scirpus validus	611	29	21.0	2– 52	19.3	1– 50	1.54	0.10–3.50
Scirpus fluviatilis	591	15	39.4	2– 149	30.5	2–100	2.10	0.25–7.50

Not only was a wide variety of plants utilized by the grebes for nesting cover, but I noted also that there was considerable variation in the frequency, height, basal area, and per cent of plot cover of the various plant species on the quadrats. The mean number of plant stems per quadrat in utilized nesting cover was 396.8 stems with a range from 0 to 1,272 stems. The relatively high vegetation density used for nesting indicated that the grebes utilized the "fringe cover," which was characterized by the abundant spike rush (*Eleo-*

charis macrostachya). Statistical analysis of the pertinent data revealed no significant correlation between nesting success and vegetation density at the nest site.

Discussion

Since vegetation density did not apparently affect the nest success to a statistically significant degree, I believe that manipulation or control of the water levels to obtain the greatest development of vegetation consistent with optimum water levels would reduce the destructiveness of the climatic factors and would assist in reducing nest losses. Similarly, water level control to the point where fluctuations were at a minimum would also benefit the nesting Pied-billed Grebes. Increased trapping of fur bearers may alleviate some of the predator pressure on the nesting population.

Summary

1. Pied-billed Grebes arrived in northwest Iowa during the last week of March in 1948.

2. Breeding activity reached its peak during the last week of May and the first part of June.

3. Sometimes both sexes of Pied-billed Grebes took part in the defense of their nesting territories, but the male usually defended the area.

4. The Pied-billed Grebe nest was a floating, truncated cone of water-soaked vegetation and required from three to seven days for construction.

5. Over 85 per cent of the nests were located within 50 feet of an open water area in the marshes, the mean distance being 25.7 feet.

6. Egg laying began about the first week of May, 1948.

7. Of the 138 nests I examined, 97 (70.4 per cent) were successful. Approximately 541 young hatched from these nests.

8. Inclement weather was the major factor affecting nest loss (50 per cent).

9. The raccoon was responsible for about 25 per cent (10 nests) of the nest loss.

10. Analysis of the data indicated that those nests located near the shore were least likely to succeed.

11. Pale spike rush (*Eleocharis macrostachya*), hard-stemmed bulrush (*Scirpus acutus*), and soft-stemmed bulrush (*Scirpus validus*) occurred on more nest-containing quadrats than did other plant species.

12. Manipulation of the water levels appears to be the best means of making northwest Iowa marshes more attractive to breeding Pied-billed Grebes.

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